

## **Stock Assessment I: Statistical and Ecological Bases for Stock Assessment**

Lecture Time: TBA

Course Description:

The first of a two class introduction to stock assessment methods, this class will focus on the statistical and ecological background which is necessary for proper understanding of stock assessment models and modeling. Current stock assessment models and methods will be covered in more depth in the second class.

We will spend the first eight weeks developing and testing students' familiarity with statistical methods, including statistical testing, ordinary least squares and maximum likelihood estimation, Monte Carlo simulation and bootstrapping, multivariate, and Bayesian methods. The next six weeks will be spent learning and testing ecological concepts such as stock distribution, catchability, recruitment, multispecies, and environmental effects.

These topics will be tested periodically, with help from regular homework assignments. Homework will be required in R, with code included, except homeworks which are noted otherwise. Each homework will be given one week to complete; no late homework will be accepted unless special permission is provided beforehand.

Objectives:

1. Demonstrate understanding of and competence with statistical methods commonly used in stock assessments.
2. Demonstrate understanding of biological, ecological, and population dynamics factors which have a bearing on stock assessment modeling.
3. Synthesize biological and statistical information in developing a stock assessment method for a chosen fishery.

Texts:

Fisheries Ecology and Management, by Carl Walters and Steven Martell

as well as weekly articles, TBA.

Week	Topic	Homework	Readings
<b>Begin Statistics of Stock Assessment</b>			
<b>1: Introduction</b>	Marine Management and Biological Reference Points	Introduction to basic techniques in R	
	Overview: Assessment Data and Methods		
<b>2: Statistical Testing</b>	Derivation of Statistical Tests (z, chi-squared, t, f-tests)	Statistical testing with data provided	
	Central Limit Theorems and root-n consistency		
<b>3: OLS and MLE</b>	OLS and Gauss-Markov Theorems (I and II)	Estimation using lm() function, as well as tests on variable significance	
	Likelihood, log-likelihood, and MLE estimation		
<b>4: Simulation and Bootstrap</b>	Introduction to Monte Carlo simulations	A simulation case-study involving individual growth curves	
	Parametric and non-parametric bootstrapping		
<b>5: Nonlinear minimization</b>	Non-linear minimization: Nelder-Mead, Simulated Annealing, Newton Methods, Conjugate Gradient	Develop R script to perform robust minimization	
	Common errors and robust methods in non-linear minimization		
<b>6: Multivariate</b>	Multivariate statistical methods	Multivariate tests on covariance matrices, developed from genetic data	
	Multivariate tests		
<b>7: Bayesian</b>	Background on Bayesian inference	Exploration of WinBUGS	
<b>8:</b>	Review for mid-term		

	<b>Mid-Term #1:</b> Introduction to Statistical Methods		
<b>Begin Ecology of Stock Assessment</b>			
<b>9: Distribution</b>	Distribution: Stock Aggregation and Fish Behaviors	Developing a script to calculate untuned VPA	
	Assessment Methods: Depletion curves and VPA		
<b>10 Catchability</b>	Catchability changes, errors, and non- stationarity	Developing a script to calculate tuned VPA, including multiple indices	
	Assessment Methods: CPUE indices		
<b>11 Recruitment</b>	Density dependence: juvenile stages and canibalism	Perform basic surplus- production model with data provided	
	Recruitment curves (Beaverton-Holt and Ricker Curves)		
<b>12 Biological Multi-Species</b>	Density-dependence: adult stage and predation	Exploration of EcoSIM	
	Biological multispecies models: EcoSim		
<b>13 Environmental Effects</b>	Oceanographic influences: temperature limits	Identification of environmental covariates in recruitment, using model parsimony	
	Akaike Information Criterion and parsimonious covariate selection		
<b>14</b>	Review for mid-term #2		
	<b>Mid-Term #2:</b> Ecological Background for Stock Assessment		
<b>15</b>	Review for final		
	<b>Cumulative Final</b>		

	<b>Exam</b>		
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